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Horizontal synchronization of neuronal activity in the barrel cortex of the neonatal rat by spindle-burst oscillations

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Abstract

© 2018 Suchkov, Sharipzyanova and Minlebaev. During development, activity in the somatosensory cortex is characterized by intermittent oscillatory bursts at gamma (early gamma-oscillations, EGOs) and alpha– beta (spindle-bursts, SBs) frequencies. Here, we explored the topography of EGOs and SBs in the neighbor barrels of the whisker-related barrel cortex of neonatal rats (P4-7) during responses evoked by simultaneous activation of multiple whiskers as it occurs during natural conditions. We found that brief simultaneous deflection of all whiskers evoked complex neuronal responses comprised of EGOs and SBs. In contrast to EGOs, that specifically synchronized neuronal activity in each individual barrel, SBs efficiently synchronized activity between neighboring barrels. After plucking a single whisker, synchronous stimulation of spared whiskers evoked EGO-lacking responses in the whisker-deprived barrel, even though the remaining neuronal activity was synchronized by SBs in neighboring barrels. Thus, EGOs specifically support topographic synchronization of neuronal activity within barrels, whereas SBs support horizontal synchronization between neighboring barrels during stimulation of multiple whiskers. We suggest that these two co-existing activity patterns coordinate activity-dependent formation of topographic maps and support the emergence of integrative functions in the primary somatosensory cortex during the critical period of somatosensory maps development.

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Keywords

Barrel cortex, Development, Early gamma oscillation, Immature cortical activity, Neonatal rat, Spindle-burst

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